NCRFC Routings

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In This Issue...

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HIC Insights

Greetings, I would like to introduce myself, Dan Luna, as the new Hydrologist-in-Charge (HIC) of the North Central River Forecast Center (NCRFC). I arrived on the scene in March, only to be greeted by a large snowpack and a long winter, or perhaps a more traditional winter by Minnesota standards. My wife and I moved from West Virginia to Minnesota and we were accustomed to dealing with floods in our state. In many cases, we had tremendous flooding in West Virginia that devastated lives and property. So flooding was not entirely new to us. What was new, was the length of flooding in much of our area. West Virginia rivers and streams rise and fall very quickly due to terrain and rainfall amounts. I knew rivers and streams did not rise and fall as quickly, but I was really surprised at how long certain areas remained above flood stage (Two months, two weeks and five days on the Mississippi River).

Some would say I really received a "baptism by fire" as I was not sure what I was really getting myself into, as far as the flooding was concerned. 2001 has been an eventful year for us. We had major flooding across much of our area, the third and fourth highest flood of record, and NCRFC staff worked around the clock for two weeks keeping a constant hydrometeorological watch. Several NCRFC folks worked more than two weeks in a row. What amazed me most was how long we held on to our snowpack and how much rain fell in April. At any rate, I am very proud of the outstanding work our office accomplished this past spring and feel fortunate to have such a fine staff. We had some incredibly long lead times this spring and verified within 1 foot of what was forecast in several locations (See our website for more details on verification). We continue to improve our forecasting and understanding of the Red River Valley, a very complex area to forecast hydrologically.

I am very excited about being here and am pushing to improve our services and forecasts. We are forging ahead with the Advanced Hydrologic Prediction Services adding another 45 forecast points previous to the summer of 2001. We just added the Grand and Iowa/Cedar Rivers in late June. This is an additional 34 forecast points. Early next spring we will add the Souris River in North Dakota. We want to experiment with some additional forecast products this fall and we continue to improve our website, adding more information. It will be a busy summer and fall for all of us at the NCRFC, bringing more AHPS sites on line, visiting and listening to our customers, experimenting with new forecast products and improving our website. If you have suggestions, please feel free to call or E-mail. We aim to please our customers!

Thank you,
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New Radar Derived Rainfall Estimator

Jay P. Breidenbach and Judith Stokes Bradberry

The current methodology for creating radar-derived estimates of rainfall , called Stage III, is being improved to address radar bias issues and to add new capabilities. The new program is called the River Forecast Center (RFC)-wide Mulitisensor Precipitation Estimator (MPE). RFC-wide MPE will provide an optimal estimate of precipitation which has fallen during a given clock hour.

RADAR ESTIMATES

The WSR-88D Precipitation Processing System (PPS) produces graphical and gridded estimates of rainfall. It is the gridded precipitation product called the hourly Digital Precipitation Array (DPA) which is used as input into the RFC-wide MPE. The DPA has a spatial resolution of approximately 4 km and a temporal resolution of 1 hour.

PROBLEMS WITH RAW RADAR ESTIMATES

There are several error sources which contribute to mean field and range dependent biases. These errors can be caused by radars which are out of calibration, the use of an inappropriate Z-R relationship when converting reflectivity to rain rate, clutter from ground targets, and bright band contamination.

The computational range of the PPS is 230 km but the true range for valid rainfall estimates is generally less than 230 km due to severe range degradation associated with beam overshoot and partial beam filling. The problem with range degradation in the precipitation estimates is more severe in stratiform rainfall situations than in convective events.

RADAR COVERAGE MAPS

For each radar, a map showing which grid points are well covered for precipitation estimation can be computed from long-term radar climatologies. The coverage map reveals which grid points cannot be reliably estimated by a specific radar due to beam blockage problems and which grid points are typically beyond the range of reliable estimation. These maps vary as a function of radar location and season. In general, warm season coverage maps usually indicate good radar coverage even at long range from the radar. Radar coverage maps derived from cool season data generally indicate no or poor coverage for grid points at long ranges from the radar. Accurate radar coverage maps from both the warm season and the cool season are needed to create accurate multi-radar precipitation mosaics.

MULTI-RADAR MOSAICS

The Multi-radar mosaic is computed by mapping data from each radar onto a larger grid which covers an entire RFC area of forecast responsibility. In areas where more than one radar covers a particular grid box, the radar which provides data at the lowest height above sea level is used in the mosaic.

The mosaic methodology of using individual radar coverage maps and then selecting the lowest available coverage may leave some grid points which are not well covered by any radar. Even though some grid points may not be defined in the radar coverage, it is better to know where the radar network provides poor coverage and use other types of data such as rain gauge or satellite to help fill in these gaps.

BIAS CORRECTION OF RADAR ESTIMATES

A mean field bias correction factor is computed for each radar and updated each hour. Once a reliable bias correction factor is computed, it is applied to the radar mosaic by multiplying it times every grid point covered by the radar for which it was computed.

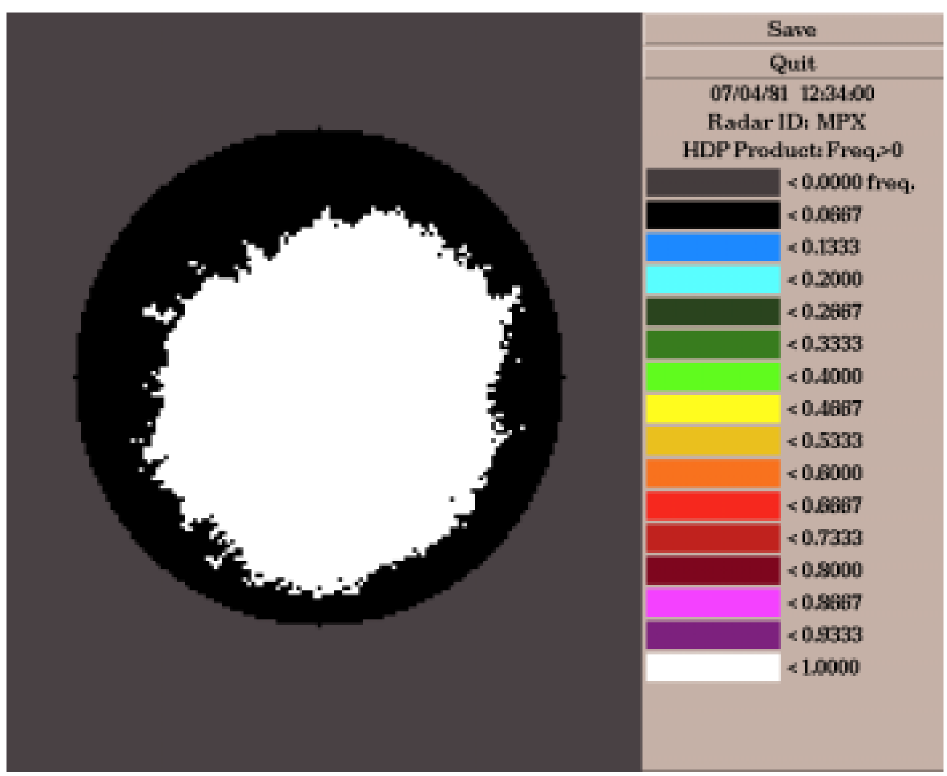
The mean field bias correction can account for bias in the radar estimates due to poor radar calibration and inappropriate Z-R relationships. However, nonuniform biases, which can vary from grid point to grid point due to radar sampling issues as well as differences in airmass or rainfall type (convective vs. stratiform), are not handled well by a mean field bias correction.

MULTI-SENSOR ESTIMATES

Rain gauge observations are merged with the estimates from the bias-corrected radar mosaic using an optimal estimation procedure. In the optimal estimation procedure, the value of each grid point is determined by weighting gauge and radar observations in the vicinity of the grid point which is being estimated. Since a gauge observation is considered to be "truth", the optimal estimate matches the gauge value at the gauge location and places a heavy weight on the gauge value in the vicinity of the gauge location. The amount of weight placed on the radar estimate at a given grid point increases as a function of distance from the nearest gauge.

HYDROLOGIC APPLICATIONS

The RFC-wide multisensor precipitation estimate can be used as input into the National Weather Service River Forecast System (NWSRFS).



AHPS Post Flood Meeting

An AHPS Post Flood Meeting was held in Chanhassen June 20, 2001. The objective of the meeting was to answer the following questions:

(1) What should the frequency of issuance of AHPS probabilistic graphics be?

Products will continue routine monthly, issuance. To allow WFOs to inform their customers about the date of issuance, NCRFC will make graphics available to WFOs no later than the Thursday following CPC monthly outlooks. Probabilistic graphics will be updated more than once per month on a case by case basis. The WFO should contact the RFC and discuss the need for an update and the RFC will either (1) prepare new graphics or (2) help WFO explain why update is not required. For example, the most recent graphics already take into account additional snowfall or rain.

(2) What AHPS probabilistic graphics should be issued during flooding?

Attendees agreed beginning in July, 2001, the weekly exceedance bar charts for stage, discharge and volume will be replaced by expected value plots. However this decision is being reconsidered due to unanticipated complications which are (a) lack of explicit customer feedback, (b) impact on consistent web page and (c) shortcomings of expected value plots. More information will be forthcoming, but WFOs should not expect to make the change until further notice from CRH.

(3) What should the forecasting procedures and products be when snowmelt begins;

NCRFC will begin issuing deterministic river forecasts when flood issuance stage (FIS) is expected to be reached or exceeded. If a WFO has not given FIS to NCRFC, then deterministic river forecasts will begin when river is expected to rise to within one foot of flood stage. WFOs are encouraged to give FIS to NCRFC for all forecast points.

B. If the FIS is not expected to be reached but customers express concern about future river levels anyway, then the WFO will notify NCRFC which will issue HCMs giving information and assurance.

C. When the FIS is expected to be reached, NCRFC will issue five day deterministic forecasts. If the crest is expected in days six to 10, then NCRFC will add a comment to the RVF giving the crest stage and date. If the crest is expected beyond day 10, then NCRFC will add a comment in a HCM to indicate the conditions to expect in days six to 10 on a case by case basis.

D. When all WFOs in NCRFCs area have implemented their digital forecast databases, then NCRFC will have access to seven day temperature forecasts so the five day deterministic river forecasts will be increased to seven days.

(4) What AHPS probabilistic graphics should be issued during low flow conditions?

Use expected value plots for low flow information unless NCRFC finds they are not applicable.

(5) What should the duration of AHPS probabilistic graphics be?

WFO FGF would like the probabilistic graphics to be increased from 90 days to 120 days for the Red River of the North in January, but NCRFC has some valid reasons to stay with 90 day duration. WFO FGF and NCRFC are looking for compromise solution which will be scientifically valid while still meeting WFO FGFs need.

Spring Flood Summary

A snow pack containing between 2 and 4 inches of water equivalent across the Bois de Sioux and Ottertail River Basins set the stage for the 2001 Red River Spring flood. This, combined with the 2 to 4 inches of rain during the melt, produced the 3rd highest floods on record at Fargo and Wahpeton, ND.

Reservoir operation and valley storage were two of several components which made forecasting peak stages extremely difficult in the Red River valley this spring. Even with these challenges minimal damage was incurred due to the advanced preparation and the lessons learned during and after the flood of 1997 Red River record flood.

In the Minnesota River Basin most forecast points experienced two crests this spring. The first crest was the result of heavy rain over the basin combined with snowmelt. The second crest was the result of more heavy rain over the Minnesota River Basin which was still flooded from the first rain event.

Prior to both events NWS meteorologists at out field offices and at the HPC were in general agreement regarding the placement and amount of rain that was expected to fall during each storm. Their confidence in the QPF prompted the use of 48 hours of QPF in the river forecasts to increase lead time. The Minnesota River forecasts listed in the following table are these initial forecasts which included 48 hours of QPF. As a result our users had one more day to prepare for each crest.

In the upper Mississippi River Basin, events were similar to those in the Minnesota River Basin. Heavy rain fell on an already swollen river causing a second crest at several locations. The double crests in these areas prolonged the flooding further downstream along the Mississippi River. Some forecast points were above flood stage well over a month.

The table on the next page shows selected forecast points in the Red, Minnesota and Mississippi River Basins and compares their initial forecast with the actual crest. Most forecasts were within a foot, and many within a half-foot. Lead time averaged around 6 days with several points getting a week or more to prepare their flood fights.

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Below is a Spring Flood Summary for selected forecast points on the major rivers in the NCRFC area. Many of the forecasts were within a half foot and on average gave a lead time of 6 days. The crest forecasts below are the first forecasts that were issued for the flooding.

Forecast point	Crest Forecast (Feet)	Observed Crest (Feet)	Difference (Feet)	Lead Time (Days)
Red River of the North				
Wahpeton, ND	19.5	16.9	2.5	3
Fargo, ND	35.0	36.6	1.6	6
Grand Forks, ND	44.0	44.9	0.9	3
Pembina, ND	50.5	49.4	1.1	13
Minnesota River				
Montevideo, MN 1st Crest	23.5-24.0	22.6	0.9	3
2nd Crest	20.0	19.2	0.8	2
Henderson, MN 1st Crest	738.5	739.2	0.7	8
2nd Crest	738.0	738.5	0.5	6
Jordan, MN 1st Crest	33.0	33.0	0.0	9
2nd Crest	32.0	32.2	0.2	7
Mississippi River				
St. Paul, MN 1st Crest	23.0-24.0	23.4	0.4	8
2nd Crest	23.5-24.5	23.7	0.2	6
Lake City, MN	20.5	20.1	0.4	4
Alma, WI	18.5	18.1	0.4	4
La Crosse, WI	16.5	16.4	0.1	6
McGregor, IA	23.0	23.7	0.7	8
Guttenburg, IA	21.5	21.7	0.2	8

NCRFCs Web Address:
http://www.crh.noaa.gov/ncrfc/

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